LISTING OF CLAIMS:

The present listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) An apparatus for detecting a direction of a target to be detected which resides in a spatial area to be tracked using radio tracking, the apparatus comprising: ~~by transmitting and receiving radio waves through~~

a plurality of transmission/reception channels causing a ~~phase~~ difference ~~in~~ between phases of two reception signals to be received through two adjacent transmission/reception channels of the transmission/reception channels, the transmission/reception channels including a transmission antenna transmitting radio waves to cover the entire spatial area in response to a transmission signal to be given, a reception antenna receiving reflected radio waves coming from the spatial area so as to produce the two reception signals in accordance with the reflected radio waves, and a receiver processing the two reception signals into processed signals ~~and calculating the direction based on the phase difference, a transmission antenna and a reception antenna included in the plurality of transmission/reception channels, the apparatus comprising;~~

a direction calculating device calculating the direction of the target based on the phase difference in the ~~received~~ reception signals on the assumption that the phase difference is within a range of $-\pi$ to $+\pi$ [rad];

a range determining device determining that the target currently exists in ~~any~~ one of a plurality of azimuthal angle ranges ~~each~~ respectively corresponding to ranges ~~defined by~~ sectioned in the spatial area between $(2m-1)\pi$ to $(2m+1)\pi$ [rad] (where m is an integer); and

a direction correcting device correcting the direction calculated by the direction calculating device according to a result determined by the range determining device.

2. (Original) The apparatus according to claim 1, further comprising a memory device for memorizing history information in relation to positional information including at least the direction target by target,

wherein the range determining device is configured to determine the azimuthal angle range on the basis of the history information memorized by the memory device.

3. (Currently Amended) The apparatus according to claim 1, further comprising an imaging device acquiring a two-dimensional image through a field of view of an angular range being wider than and including the azimuthal angle range corresponding to the range of $-\pi$ to $+\pi$ [rad] ~~of~~ which is the ~~phase~~ difference between the phases of the two reception signals; and

a distance calculating device calculating a ~~difference of~~ distance between the apparatus and the target based on ~~transmitted and received signals of the radio waves~~ both of the transmission and the processed signals,

wherein the range determining device comprises:

a mapping member configured to map, every azimuthal angle range, a position at which the target is to be detected on the two-dimensional image acquired by the imaging device on the basis of each direction ~~respectively~~ calculated using the phase difference between the ~~received~~ reception signals on the assumption that the phase difference is within each of ranges defined by $(2m-1)\pi$ to $(2m+1)\pi$ [rad] and the distance calculated by the distance calculating device;

a first determination member configured to determine whether or not the target is imaged at each position on the two-dimensional image acquired by the mapping member; and

a second determining member configured to determine the azimuthal angle range in which the target exists, on the basis of a determined result of the first determination member.

4. (Original) The apparatus according to claim 3, wherein the imaging device is a CCD camera.

5. (Currently Amended) The apparatus according to claim 1,

wherein the transmission antenna is composed of one transmission antenna that forms part of one transmission channel, ~~one of a plurality of transmission antennas and~~

wherein the reception antenna is composed of ~~one of plural~~ a plurality of reception antennas, ~~to~~ that form part of a plurality of reception channels ~~involved in~~, and

wherein the plurality of transmission/reception channels are composed of a combination of the one transmission channel and the plurality of reception channels, ~~the transmission antenna transmitting the radio waves into an overall area to be detected and the plural reception antennas receiving radio waves reflected from the area~~.

6. (Original) The apparatus according to claim 5, wherein the plural reception antennas are linearly arranged and are spaced apart at equal intervals.

7. (Currently Amended) The apparatus according to claim 6,

wherein the one transmission channel includes the transmission antenna and ~~is coupled with~~ a transmitter for ~~transmitting the radio waves via~~ providing the transmission signal to the transmission antenna, ~~and~~

wherein each of the plurality of reception channels includes a path connected to each of the plural reception antennas, each path including a mixer, an amplifier, and an analog-to-digital converter arranged in order from each reception antenna, and

wherein each mixer receives a corresponding one of the reception signals ~~signal~~ from each reception antenna and a local signal ~~from the transmitter~~, and mixes the received reception signal with the ~~received~~ local signal to produce a mixed signal,

each amplifier amplifies the mixed signal from each mixer to produce an amplified signal, and

each analog-to-digital converter converts the amplified signal from each amplifier to produce a corresponding digital signal.

8. (Original) The apparatus according to claim 1, wherein the radio waves are millimeter wave-band radio frequency waves.

9. (Currently Amended) The apparatus according to claim 2,

wherein the transmission antenna is composed of ~~there is~~ one transmission antenna that forms part of one transmission channel, ~~and~~

wherein the reception antenna is composed of ~~one of plural~~ a plurality of reception antennas~~, to~~ that form part of a plurality of reception channels, and ~~involved in~~

wherein the plurality of transmission/reception channels are composed of a combination of the one transmission channel and the plurality of reception channels~~, the transmission antenna transmitting the radio waves into an overall area to be detected and the reception antennas receiving radio waves reflected from the area~~.

10. (Original) The apparatus according to claim 9, wherein the plural reception antennas are linearly arranged and spaced apart at equal intervals.

11. (Currently Amended) The apparatus according to claim 10,

wherein the one transmission channel includes the transmission antenna and ~~is coupled with~~ a transmitter for ~~transmitting the radio waves via~~ providing the transmission signal to the transmission antenna, ~~and~~

wherein each of the plurality of reception channels includes a path connected to each of the plural reception antennas, each path including a mixer, an amplifier, and an analog-to-digital converter arranged in order from each reception antenna, and

wherein each mixer receives a corresponding one of the reception signals ~~signal~~ from each reception antenna and a local signal ~~from the transmitter~~, and mixes the received reception signal with the ~~received~~ local signal to produce a mixed signal,

each amplifier amplifies the mixed signal from each mixer to produce an amplified signal, and

each analog-to-digital converter converts the amplified signal from each amplifier to produce a corresponding digital signal.

12. (Currently Amended) The apparatus according to claim 3,

wherein the transmission antenna is composed of ~~there is~~ one transmission antenna that forms part of one transmission channel, ~~and~~

wherein the reception antenna is composed of ~~one of plural~~ a plurality of reception antennas, ~~to~~ that form part of a plurality of reception channels ~~involved in~~,

wherein the plurality of transmission/reception channels are composed of a combination of the one transmission channel and the plurality of reception channels, ~~the transmission antenna transmitting the radio waves into an overall area to be detected and the reception antennas receiving radio waves reflected from the area~~.

13. (Original) The apparatus according to claim 12, wherein the plural reception antennas are linearly arranged and spaced apart at equal intervals.

14. (Currently Amended) The apparatus according to claim 13,

wherein the one transmission channel includes the transmission antenna and ~~is coupled with~~ a transmitter for ~~transmitting the radio waves via~~ providing the transmission signal to the transmission antenna, ~~and~~

wherein each of the plurality of reception channels includes a path connected to each of the plural reception antennas, each path including a mixer, an amplifier, and an analog-to-digital converter arranged in order from each reception antenna, and

wherein each mixer receives a corresponding one of the reception signals ~~signal~~ from each reception antenna and a local signal ~~from the transmitter~~, and mixes the received reception signal with the ~~received~~ local signal to produce a mixed signal,

each amplifier amplifies the mixed signal from each mixer to produce an amplified signal, and

each analog-to-digital converter converts the amplified signal from each amplifier to produce a corresponding digital signal.

15. (New) An apparatus for detecting a direction of a target to be detected which resides in a spatial area to be tracked using radio tracking, the apparatus comprising:

a plurality of transmission/reception channels causing a difference between phases of two reception signals to be received through adjacent two transmission/reception channels of the transmission/reception channels, the transmission/reception channels including a transmission antenna transmitting radio waves to cover the entire spatial area in response to a transmission signal to be given, a reception antenna receiving reflected radio waves coming from the spatial area so as to produce the reception signal in accordance with the reflected radio waves, and a receiver processing the reception signal into processed signals; and

a signal processor configured to

calculate the direction of the target based on the phase difference in the reception signals on the assumption that the phase difference is within a range of $-\pi$ to $+\pi$ [rad],

determine that the target currently exists in one of a plurality of azimuthal angle ranges respectively corresponding to ranges sectioned in the spatial area between $(2m-1)\pi$ to $(2m+1)\pi$ [rad] (where m is an integer), and

correct the direction calculated by the direction calculating device according to a result determined by the range determining device.

16. (New) The apparatus according to claim 15,

wherein the transmission antenna is composed of one transmission antenna that forms part of one transmission channel,

wherein the reception antenna is composed of a plurality of reception antennas that form part of a plurality of reception channels, and

wherein the plurality of transmission/reception channels are composed of a combination of the one transmission channel and the plurality of reception channels.

17. (New) The apparatus according to claim 16, wherein the plurality of reception antennas are linearly arranged and are spaced apart at equal intervals.

18. (New) The apparatus according to claim 17,

wherein the one transmission channel includes the transmission antenna and a transmitter for providing the transmission signal to the transmission antenna,

wherein each of the plurality of reception channels includes a path connected to each of the plurality of reception antennas, each path including a mixer, an amplifier, and an analog-to-digital converter arranged in order from each reception antenna, and

wherein

each mixer receives a corresponding one of the reception signals from each of the plurality of reception antennas and a local signal, and mixes the received reception signal with the local signal to produce a mixed signal,

each amplifier amplifies the mixed signal from each mixer to produce an amplified signal, and

each analog-to-digital converter converts the amplified signal from each amplifier to produce a corresponding digital signal.

19. (New) The apparatus according to claim 17, wherein the radio waves are millimeter wave-band radio frequency waves.